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Results of Comparative Age Reading of Greenland Halibut *Reinhardtiu hippoglossoides* (Walbaum) by Scales and Otoliths

by

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Abstract

Results of comparative reading of Greenland halibut age by otoliths and scale from three parts of the body are presented. Reliability of differences was assessed with the use of Fisher's Z-criterion.

Discrepancies in age reading between various structures varied from 1 to 3 years, but in most cases age difference did not exceed 1 year. A number of variant readings was quite large in all discussed cases and varied from 28.8 to 33.3 % and constituted on average 31.2 %.

Investigations proved the statistical reliability of differences by materials, in which scales were used taken from under the pectoral fin. It turned out, that results of age reading by scales from this part are sufficiently underestimated. Comparison between spinal and tail parts and otoliths showed that these differences are big, but statistically unreliable.

Introduction

Knowledge of age structure of commercial marine objects is necessary for estimation and prediction of commercial fish stock dynamics. Since 1940's PINRO has tested various recording structures to reveal the most suitable one for age reading (Milinsky, 1944). These tests have shown that the best structure is scales. Since 1970's PINRO finally changed to age reading by scales from the spinal part. However, in other countries age has been determined by otoliths for decades (Krzykawski 1975, 1976; Igashov, 2001; Igashov, MS 2001). At present, the Institute resumed the comparative age reading by scales and otoliths. The aim of these investigations is determination of systematic differences, the knowledge of which will promote the subsequent closing in of results of age reading by Russian and foreign scientists.

Materials and Methods

Materials for investigations were collected in 2002 in the Division 3L. A sample consisted of specimens 22-89 cm long. For comparative age reading otoliths were taken from each individual, as well as scales from three parts of the body on the eye side: under the spinal fin higher than the side line, under the pectoral fin and on the tail part of the body higher than the side line (Figure 1). A number of individuals, by whom the age reading comparison can be carried out, varied from 132 to 174 individuals (Table 1). Reliability of differences of age reading between various structures was estimated by Fischer's Z-criterion.

Results and Discussion

Discrepancies in age determination by different structures varied from 1 to 3 years, but in most cases the age difference did not exceed 1 year. Total number of variant readings turned out to be quite high in all discussed cases and varied from 28.8 to 33.3% and constituted 31.2% on average (Table 1).

The largest number of divergences was revealed at the comparative age reading by scales taken under the pectoral fin and by other structures. For example, compared to the spinal scales, the age was underestimated in 29.9 % of cases. Compared to the tail scales and otoliths the given structure has revealed the underestimation of age with frequencies of 25.2 and 26.8%, correspondingly. Testing with the use of Fischer's criterion has revealed the reliability of age readings in regard to the pectoral scales. In all cases, $|Z|$ exceeded much the table values of Z_α at both sufficient and high levels of significance.

The pointed out habits can be explained by differences in sizes of scales from various parts of the body. It was found earlier that in most of fish the size of scales decreases from the tail to the head (Krzykawski, 1976). S. A. Krzykawski carried out the reciprocal calculation of growth rate with the use of scales from various parts of the body and otoliths of Greenland halibut from the area of Newfoundland and the Barents Sea. As a result, he concluded that diminishing of scales' size in the direction of the head is peculiar for this species.

Concerning our investigations: since the pectoral part is the closest to the head, therefore, scales there should be smaller than in other parts. Since a scale radius there is much less, so the underestimation of age is probable when counting year rings.

If to follow the pattern found by S. A. Krzykawski, then compared to pectoral scales a part of age underestimations by the spinal scales should be much less then that by the tail scales. However, our investigations did not prove that. Results of age reading by scales taken from the spinal and tail parts higher than the sideline are more homogeneous for age determination compared to results obtained by the pectoral scales. To opinion of S. A. Krzykawski, the scales taken slightly higher than the sideline in the tail part of the body are the most suitable for age reading.

Age determined by the pectoral scales are sufficiently underestimated compared to both the standard national method with the use of the spinal scales and scales from the tail part, which is recommended by S. A. Krzykawski, and the standard foreign method of age reading by otoliths.

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Table 1. Comparative results for age determination by scales from various parts of the body and by otoliths.

Parameters for comparison of discrepancies	Indices by pairs of comparisons by different structures					
	D-P	**C-P**	**O-P**	D-C	D-O	C-O
A number of individuals for comparison in a sample – n	174	159	142	165	147	132
A number of discrepancies to a lesser extent – x1, ind.	52	40	38	32	24	16
A number of discrepancies to a greater extent x2, ind.	6	7	8	23	19	22
Total number of discrepancies	58	47	46	55	43	38
Frequency of discrepancies to a lesser extent , %	**29.9**	**25.2**	**26.8**	19.4	16.3	12.1
Frequency of discrepancies to a greater extent, %	**3.4**	**4.4**	**5.6**	13.9	12.9	16.7
Total frequency of discrepancies, %	33.3	29.6	32.4	33.3	29.3	28.8
Actual value of a module Z-criterion of Fischer - |Z|	**6.62**	**5.21**	**4.83**	1.33	0.83	1.05
Table value of Z criterion at the sufficient level of magnitude $\alpha = 0.05$, Z_α	**1.96**	**1.96**	**1.96**	1.96	1.96	1.96
Table value of Z criterion under the high level of a significance $\alpha = 0.001$, Z_α	**3.29**	**3.29**	**3.29**	3.29	3.29	3.29

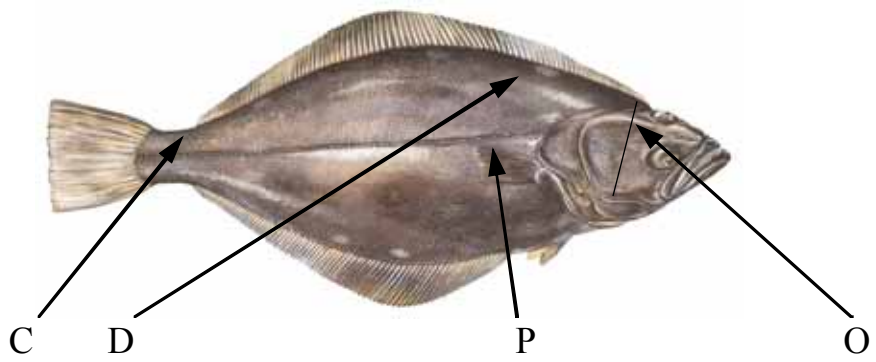

Fig. 1. Parts for collection of recording structures for age determination of Greenland halibut.

C – the tail part – a site for collection of scales recommended by Krzykawski (1976);
D – the spinal part – a site for collection of scales most frequently used for majority of fish species;
P – a site of collection of scales close to the pectoral fin;
O – a site of incision for otoliths' collection.